

CS 310 Sample Exam 1: DFA/NFA/Regular Expression/GNFA

The Alphabet for each language is $\{0, 1\}$

1. Build a DFA and give one string in the language and one string not in the language (neither of these strings should be the empty string if you can avoid it)

$\{ w \mid w \text{ contains substring } 1010 \}$
 $\{ w \mid w \text{ has an even number of 0s and } |w| > 4 \}$
 $(101)^*111(01)^*111$

2. Build an NFA and give one string in the language and one string not in the language (neither of these strings should be the empty string if you can avoid it)

$\{ w \mid \text{every even position of } w \text{ is } 0, |w| \geq 2 \}$
 $(101)^*1(010)^*$
 $\{ w \mid |w| > 0 \}$

For the following three questions, provide the complete machine produced by the lemmas described in your book. **Do no remove non-necessary states and transitions.**

3. Concatenate NFAs

Use the lemma described in the book to concatenate the following two languages:

$A = \{ w \mid \text{contains substring } 1010 \}$
 $B = \{ w \mid w \text{ ends with } 00 \}$

Produce the machine for the language AB

4. Union NFAs

Use the lemma described in the book to union the following two languages:

$A = \{ w \mid \text{begins with } 00 \text{ and ends with } 11 \}$
 $B = \{ w \mid w \text{ contains the substring } 11 \}$

Produce the machine for the language $A \cup B$

5. Kleene Star NFAs

Build a NFA that represents the Kleene star of this language. Show the NFA for the original language (A) and for the Kleene star (A^*).

$A = \{ w \mid 1^*0^*0101 \}$

6. Convert a DFA to a Regular Expression using GNFA's

Transform the following DFA to a Regular Expression using the GNFA state removal method. **Show the GNFA after each state removal.**

Sipser Figure 1.8 page 37

7. Produce a Regular Expression

{ w | (starts with 1 and has 1010 as a substring or starts with 0 and has an odd length)
and $|w| > 0$ }

8. Convert an NFA to a DFA

Convert this NFA to a DFA, remove all non-necessary states. Be sure to indicate which set of states in the NFA each state in the DFA represents.

Sipser figure 1.27 page 48

10. Discuss NFA/GNFA/DFA/RES

We have discussed NFAs, GNFA's, DFAs, and regular expressions. Explain, using a few English sentences, the relationships between these concepts.

11. Regular Expressions:

We use three operations to create regular expressions. What are they? Why do we use those three operations? Answer each of these questions using at least one English sentence.